What is claimed is:

1. An ink-jet recording head comprising:

a passage-forming substrate having a pressure generating chamber formed thereon, which communicates with a nozzle orifice; and

a piezoelectric element formed of a thin film and by a lithography method in a region corresponding to said pressure generating chamber via a vibration plate constituting a portion of said pressure generating chamber,

wherein a space portion communicating with said pressure generating chamber and having at least one surface constituted of said vibration plate is provided in a region opposite said pressure generating chamber, which is between said passage-forming substrate and said vibration plate, and at least a width of said pressure generating chamber, which is close to said space portion, is equal to the width of the space portion or less.

2. The ink-jet recording head according to claim 1, wherein at least a width of said pressure generating chamber, which is close to said vibration plate, is approximately equal to the width of said space portion, and the outer peripheries of both sides of the space portion in the width direction regulate the width of said pressure generating chamber.

3. The ink-jet recording head according to claim 2, wherein at least a portion of the side surface of said pressure generating chamber is constituted of a slanted surface slanting from said space portion to the inside of the pressure generating chamber.

4. The ink-jet recording head according to claim 3, wherein said slanted surface includes an etching stop surface of said passage-forming substrate.

5. The ink-jet recording head according to claim 1, wherein a passage-forming layer is provided between said passage-forming substrate and said vibration plate, and said space portion is formed so as to penetrate said passage-forming layer.

6. The ink-jet recording head according to claim 5, wherein said passage-forming layer comprises boron-doped polysilicon.

7. The ink-jet recording head according to claim 1, wherein said vibration plate has a step difference portion extending to a direction crossing with the plane direction in a region corresponding to each pressure generating chamber, and said space portion is defined by said step difference portion.

8. The ink-jet recording head according to claim 7, wherein a reinforcement

layer that is provided so as to be tightly attached to said step difference portion is provided at least in a region corresponding to the outside of said space portion in the width direction.

9. The ink-jet recording head according to claim 8, wherein said reinforcement layer in the region corresponding to each of both sides of said piezoelectric element in the width direction is extended to the upper portion of said step difference portion, which is close to said piezoelectric element, and the vibration region of said vibration plate is regulated by a gap between said reinforcement layers.

10. The ink-jet recording head according to claim 8, wherein a thickness of said reinforcement layer is thicker than the height of the step difference portion of said vibration plate.

11. The ink-jet recording head according to claim 8, wherein said reinforcement layer includes an uncontinuous piezoelectric layer that is uncontinuous with the piezoelectric layer of said piezoelectric element.

12. The ink-jet recording head according to claim 1, wherein the height of said space portion ranges from 0.1 μm to 100 μm.

13. The ink-jet recording head according to claim 12, wherein the height of said space portion ranges from 1 μm to 10 μm.

14. The ink-jet recording head according to claim 1, wherein an expansion portion having a width wider than the pressure generating chamber and wider than said nozzle orifice is provided in the vicinity of said nozzle orifice of said pressure generating chamber.

15. The ink-jet recording head according to claim 1, wherein the width of said space portion is wider than the width of the piezoelectric active portion constituting said piezoelectric element, and the relation between width W_A of said pressure generating chamber and width W_B of said piezoelectric active portion satisfies $W_A < W_B$.

16. The ink-jet recording head according to claim 1, wherein an insulation layer having an open portion in a region opposite said pressure generating chamber is provided on a surface of said passage-forming substrate which is opposite said vibration plate, and a portion of said insulation layer projects into the region opposite said pressure generating chamber.

17. The ink-jet recording head according to claim 1, wherein said passage-forming substrate consists of a single crystal silicon substrate, and said pressure generating chamber is formed by anisotropic etching.

18. An ink-jet recording apparatus comprising the ink-jet recording head according to claim 1.

19. A manufacturing method for an ink-jet recording head, which comprises: a passage-forming substrate having a pressure generating chamber formed thereon, which communicates with a nozzle orifice; and a piezoelectric element formed of a thin film and by a lithography method in a region corresponding to said pressure generating chamber via a vibration plate constituting a portion of said pressure generating chamber, in which a passage-forming layer is provided between said passage-forming substrate and said vibration plate, and the passage-forming layer has a space portion formed in a region opposite to said pressure generating chamber, the manufacturing method of an ink-jet recording head comprising the steps of:

forming said passage-forming layer on said passage-forming substrate and imparting etching selectivity to a region that will be said space portion of the passage-forming layer;

forming said vibration plate on said passage-forming layer and forming a piezoelectric element on the vibration plate; and

performing anisotropic etching for said passage-forming substrate from a surface opposite that having said passage-forming layer to form a penetrated portion at least to a region that will be said space portion of said passage-forming layer, etching said passage-forming layer to form said space portion, and forming a pressure generating chamber opposite the space portion.

20. The manufacturing method of an ink-jet recording head according to claim 19, wherein said passage-forming layer comprises polysilicon, and etching selectivity is imparted by doping boron onto a region other than the region that will be said space portion.

21. A manufacturing method of an ink-jet recording head, which comprises: a passage-forming substrate having a pressure generating chamber formed thereon, which communicates with a nozzle orifice; and a piezoelectric element formed of a thin film and by a lithography method in a region corresponding to said pressure generating chamber via a vibration plate constituting a portion of said pressure generating chamber, in which a passage-forming layer that comprises of boron-doped polysilicon is provided between said passage-forming substrate and said vibration plate, and the passage-forming layer has a space portion formed in a region opposite said

pressure generating chamber, the manufacturing method of an ink-jet recording head comprising the steps of:

forming a polysilicon layer on said passage-forming substrate;

doping boron onto a region other than a region in which said space portion of the polysilicon layer is formed to make said passage-forming layer;

forming said vibration plate on said passage-forming layer and forming a piezoelectric element on the vibration plate;

etching said passage-forming substrate from a surface opposite that having said passage-forming substrate to form said pressure generating chamber; and

etching entirely the region of said polysilicon layer other than the region having boron doped thereon from said pressure generating chamber to form said space portion.

22. The manufacturing method of an ink-jet recording head according to claim 21, wherein the step of forming said pressure generating chamber and the step of forming said space portion are continuously performed.